



Our 10th month! Electrical code issues and answers.

● Sizing the grounding electrode conductor

Article 250-23(a) of the National Electrical Code (NEC) requires that if a premises wiring system is supplied by an AC service that is grounded, a grounding electrode conductor must be installed to connect the grounding electrode to the grounded circuit (neutral) conductor at the service. NEC 250-94 requires that the grounding electrode conductor be sized according to Table 250-94 based on the size of the service entrance conductors unless otherwise permitted by exception.

When conductors are run in parallel (electrically joined at both ends to form a single conductor) the total circular mil area of all conductors in a set of conductors must be used in determining the size of the grounding electrode conductor. This is very straightforward when using conductors that are marked in thousand circular mils (kcmil). If you have two 250 kcmil copper conductors in parallel, the sum is 500 kcmil. Table 250-94 requires the use of a 1/0 AWG copper or 3/0 AWG aluminum grounding electrode conductor.

If you have three 1/0 AWG copper conductors in parallel, how do you size the grounding electrode conductor? Since the kcmil size is not marked on the conductor, a simple calculation is required. Table 8 in Chapter 9 of the NEC lists the circular mil area of conductors that are marked in American Wire Gauge (AWG). A 1/0 AWG conductor has an area of 105,600 circular mils. The sum of three conductors is 316,800 circular mils (316.8 kcmil). Table 250-94 requires a #2 AWG copper or 1/0 AWG aluminum grounding electrode conductor when copper service entrance conductors over 3/0 AWG through 350 kcmil are installed.

● Sizing equipment grounding conductors

Equipment grounding conductors must be sized by Table 250-95 of the National Electrical Code. The conductor size is based on the ampere rating of the overcurrent protection device that protects the circuit conductors. When a single equipment grounding conductor is run with multiple circuits (or parallel conductors) in the same raceway, it shall be **sized for the largest overcurrent device** protecting conductors in the raceway. Where parallel runs of conductors are installed in separate raceways, the equipment grounding conductor **in each raceway** must be full-sized and based on the ampere rating of the overcurrent device protecting the conductors.

Example #1: One 500 kcmil THWN copper conductor per phase is installed in a single non-metallic conduit and is protected by a 400 amp overcurrent device. Table 250-95 requires a #3 AWG copper or #1 AWG aluminum equipment grounding conductor be installed in the raceway.

Example #2: Three 1/0 AWG THWN copper conductors per phase are installed in parallel in three non-metallic conduits and this installation is also protected by a 400 amp overcurrent device. Table 250-95 requires that a #3 AWG copper or #1 AWG aluminum equipment grounding conductor be installed **in each of the three separate raceways**.

All of the requirements for running conductors in parallel in NEC 310-4 also apply to equipment grounding conductors run in parallel, with the exception that equipment grounding conductors shall be sized per NEC 250-95 and are permitted to be smaller than 1/0 AWG. It should also be noted that when phase conductors are adjusted in size to compensate for voltage drop, equipment grounding conductors must be adjusted in size proportionately according to circular mil area.

● Access to inspect installations of elevated signs or equipment

Installations of pole or building mounted electric signs (or other electrical installations that require special equipment for access) must be inspected. WAC 296-46-090 requires that *"At the time of inspection electrical wiring subject to this chapter must be sufficiently accessible to permit the inspector to visually inspect the installation to verify conformance with the National Electrical Code and any other requirements of chapter 296-46 WAC."* The electrical contractor's designated administrator is required to *"ensure that all electrical work complies with the electrical installation laws and rules of the state."* The contractor that performs an electrical

installation requiring bucket or ladder trucks, scaffolding, special ladders, or other such equipment must make that equipment available to conduct the electrical inspection. The contractor should make prior arrangements with the electrical inspector to provide access to conduct these inspections. The department's inspectors will make every possible effort to accommodate the electrical contractor's schedule.

● **Cable tray system bonding and grounding**

In general, cable trays are required to be installed as a complete system. NEC 318-7 requires all metallic cable trays that support electrical conductors to be grounded per NEC 250. Separate cable tray systems are permitted to be mechanically discontinuous between cable tray runs or between the cable tray runs and equipment served. However, support for the cables must be maintained in accordance with their respective requirements in Chapter 3; and all discontinuous metal cable tray runs or raceways routing conductors between cable tray runs and equipment must be bonded in conformance with NEC 250-75. This bonding requirement applies to all cable trays containing power conductors, control and/or signal conductors, or limited energy or communications conductors.

Proper bonding means electrical continuity and the capacity to conduct safely any fault current likely to be imposed on the bonding connections. "Likely to be imposed" currents would never be less than the overcurrent protection for the largest power conductors contained within the cable tray (per NEC 250-95) and could be much higher than that value if there were larger capacity circuits (outside of the cable tray) capable of contacting the metal cable trays or raceways under fault conditions. Listed lugs or bonding bushings with bonding jumpers, or listed fittings approved for the purpose must be used for these bonding connections.

● **Manufactured/mobile home inspections and permits**

Manufactured/mobile homes are engineered structures that require electrical, mechanical, and structural plan review before they are built. The construction of these units is under the jurisdiction of the department's Factory Assembled Structures (FAS) section. Installations that effect a unit's mechanical systems or design, or add load to the unit's interior electrical panel, such as interior wiring alterations, air conditioners, heat pumps, electrical furnaces, and other equipment located in, on, or immediately adjacent to the home require a **Factory Assembled Structure Alteration Permit** and inspection by the (FAS) construction compliance inspector. Structures that are not part of the original plan approval of the home, but are attached or supported from the mobile home, require an alteration permit and inspection by FAS.

Electrical service and the feeder to a manufactured/mobile home sub panel, frame bonding connections, and the field connection of crossover wiring between sections are under the jurisdiction of the department's Electrical Inspection section and require an **Electrical Work Permit** and inspection by the electrical inspector. Installations such as area lighting, detached carports, garages, pumps and well houses also require an electrical work permit and inspection by the electrical inspector. It is typical for these circuits or feeders to originate in the accessory disconnect space required by NEC 550-23(c) in the mobile home service equipment.

If installers or property owners choose to supply circuits for buildings and/or equipment (under the jurisdiction of the Electrical Inspection section) from the panel located inside the manufactured/mobile home, there are additional requirements that must be met. Because these are engineered units, a load calculation for the home (supplied by the installer) must be available for use by the electrical inspector to evaluate the additional load on the system. Circuits or feeders from the mobile home's panel that are routed under the chassis on surfaces exposed to physical damage during transport or set-up must be protected by rigid metal conduit, intermediate metal conduit, or schedule 80 rigid non metallic conduit. Electrical metallic tubing (EMT) or schedule 40 rigid non metallic conduit may be used on protected surfaces if closely routed against frames and equipment enclosures. All raceways must terminate in a junction box that is located under the home adjacent to the outside wall. The conductors must be suitable for wet locations. Cable type wiring methods are not approved on the surface under a mobile home chassis.

It is the intent of the department to require only one of the above permits whenever possible. However, there may be installations that require both an alteration permit and electrical permit. Please call the local FAS or electrical inspector if you have an installation that you are not sure about, before you obtain a permit. It should also be noted, that some structures and alterations may require a permit from the local building authority.

● **Target Date for 1999 National Electrical Code Adoption**

The tentative WAC rule filing date is November 4, 1998. Public hearings will be scheduled for December 11, 1998 in Tumwater and December 16, 1998 in Spokane. The tentative effective date for the 1999 NEC is February 26, 1999.